

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a semiconductor island being formed as an active layer over a substrate;
a first insulating layer being formed between the substrate and the active
5 layer,

said first insulating layer including:

a first silicon nitride oxide film having a first nitrogen concentration
higher than a first oxygen concentration, and

10 a second silicon nitride oxide film having a second nitrogen
concentration lower than a second oxygen content; and

a second insulating layer being formed in contact with a surface of the active
layer at an opposite side to the substrate,

said second insulating layer including:

15 a plurality of third silicon nitride oxide films each having a third nitrogen
concentration lower than a third oxygen concentration.

2. A device according to claim 1,

wherein the active layer has a tensile stress,

wherein the first silicon nitride oxide film of the first insulating film has a
tensile stress, and

20 wherein each of the plurality of third silicon nitride oxide films of the second
insulating layer has a compressive stress.

3. A device according to claim 1,

wherein the first nitrogen concentration of the first silicon nitride oxide film
is not less than 25 atomic % and less than 50 atomic %, and

25 wherein the third nitrogen concentration of each of the third silicon nitride

oxide films is not less than 5 atomic % and less than 25 atomic %.

4. A semiconductor device comprising:

a semiconductor island being formed as an active layer over a substrate;

a first insulating layer being formed between the substrate and the active layer

5 and including a first plurality of insulating films; and

a second insulating layer being formed in contact with a surface of the active layer at an opposite side to the substrate and including a second plurality of insulating films;

wherein the active layer has a tensile stress, and

10 wherein at least one of the first plurality of insulating films of the first insulating layer has a tensile stress.

5. A semiconductor device comprising:

a semiconductor island being formed as an active layer over a substrate;

a first insulating layer being formed between the substrate and the active layer

15 and including a first plurality of insulating films; and

a second insulating layer being formed in contact with a surface of the active layer at an opposite side to the substrate side and including a second plurality of insulating films;

wherein the active layer has a tensile stress, and

20 wherein at least one of the second plurality of insulating films of the second insulating layer has a compressive stress.

6. A semiconductor device comprising:

a semiconductor island being formed as an active layer over a substrate;

a first insulating layer being formed between the substrate and the active layer

25 and including a first plurality of insulating films; and

a second insulating layer being formed in contact with a surface of the active layer at an opposite side to the substrate and including a second plurality of insulating films;

wherein the active layer has a tensile stress,

5 wherein at least one of the first plurality of insulating film of the first insulating layer has a tensile stress, and

wherein at least one of the second plurality of insulating film of the second insulating layer has a compressive stress.

7. A semiconductor device comprising:

10 a semiconductor island being formed as an active layer over a substrate;
a first insulating layer being formed between the substrate and the active layer and including a first plurality of insulating films;

an electrode for applying a voltage to the active layer through the first insulating layer; and

15 a second insulating layer being formed in contact with a surface of the active layer at an opposite side to the substrate and including a second plurality of insulating films;

wherein the active layer has a tensile stress,

wherein at least one of the first plurality of insulating films of the first insulating layer has a tensile stress, and

wherein at least one of the second plurality of insulating films of the second insulating layer has a compressive stress.

8. A semiconductor device comprising:

20 a semiconductor island being formed as an active layer over a substrate;
a first insulating layer being formed between the substrate and the active layer and including a first plurality of insulating films;

a second insulating layer being formed in contact with a surface of the active layer at an opposite side to the substrate including a second plurality of insulating films;

an insulating film of the second insulating layer being in contact with the 5 active layer; and

an electrode for applying a voltage to the active layer through the insulating film of the second insulating layer;

wherein the active layer has a tensile stress,

wherein at least one of the first plurality of insulating films of the first 10 insulating layer has a tensile stress, and

wherein at least one of the second plurality of insulating films of the second insulating layer has a compressive stress.

9. A semiconductor device comprising at least a thin film transistor, said thin film transistor including:

15 a first silicon nitride oxide film including nitrogen at a first concentration and being formed on an insulating surface;

a second silicon nitride oxide film including nitrogen at a second concentration and being formed on the first silicon nitride oxide film;

20 a crystalline semiconductor island being formed on the second silicon nitride oxide film;

a gate insulating film comprising a third silicon nitride oxide film including nitrogen at a third concentration and being formed on the crystalline semiconductor island;

25 a gate electrode being formed over the crystalline semiconductor island with the gate insulating film therebetween;

an interlayer insulating film being formed on the gate electrode and the gate insulating film,

wherein the first concentration is higher than each of the second and third concentrations,

wherein the first silicon nitride oxide film has a tensile stress while each of the second silicon nitride oxide film and the interlayer insulating film has a compressive 5 stress.

10. A device according to claim 4,

wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

10 11. A device according to claim 4,

wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

12. A device according to claim 1,

15 wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

13. A device according to claim 1,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount 20 display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

14. A method of fabricating a semiconductor device, said method comprising the steps of:

forming a semiconductor island having a tensile stress as an active layer over a substrate;

forming a first insulating layer having a tensile stress between the substrate and the active layer; and

5 forming a second insulating layer having a compressive stress at an opposite side to the substrate of the active layer.

15. A method of fabricating a semiconductor device, said method comprising the steps of:

forming a semiconductor film over a substrate;

10 forming a first insulating layer between the substrate and the semiconductor film;

providing a tensile stress to the first insulating layer and the semiconductor film by a heat treatment;

15 forming a semiconductor island as an active layer by separating the semiconductor film; and

forming a second insulating layer having a compressive stress at an opposite side to the substrate of the active layer.

16. A method of fabricating a semiconductor device, said method comprising the steps of:

20 forming a semiconductor island having a tensile stress as an active layer over a substrate;

forming a first insulating layer having a tensile stress between the substrate and the active layer;

25 forming a second insulating layer having a compressive stress at an opposite side to the substrate of the active layer; and

forming an electrode for applying a voltage to the active layer through the

second insulating layer.

17. A method of fabricating a semiconductor device, said method comprising the steps of:

- forming a semiconductor island having a tensile stress as an active layer over a substrate;
- forming an electrode for applying a voltage to the active layer through a first insulating layer;
- forming the first insulating layer having a tensile stress between the substrate and the active layer; and
- 10 forming a second insulating layer having a compressive stress at an opposite to the substrate of the active layer.

18. A method of fabricating a semiconductor device including a thin film transistor, said method comprising the steps of:

- 15 forming a first silicon nitride oxide film including nitrogen at a first concentration on an insulating surface;
- forming a second silicon nitride oxide film including nitrogen at a second concentration on the first silicon nitride oxide film;
- 20 forming a crystalline semiconductor island on the second silicon nitride oxide film;
- forming a gate insulating film comprising a third silicon nitride oxide film including nitrogen at a third concentration on the crystalline semiconductor island;
- forming a gate electrode over the crystalline semiconductor island with the gate insulating film therebetween;
- 25 forming an interlayer insulating film on the gate electrode and the gate insulating film,
- wherein the first concentration is higher than each of the second and third

concentrations,

wherein the first silicon nitride oxide film has a tensile stress while each of the second silicon nitride oxide film and the interlayer insulating film has a compressive stress.

5 19. A method according to claim 14,

wherein the first insulating layer includes a first silicon nitride oxide film having a nitrogen concentration of not less than 25 atomic % and less than 50 atomic %, and the second insulating layer includes a second silicon nitride oxide film having a nitrogen concentration of not less than 5 atomic % and less than 25 atomic %.

10 20. A method according to claim 14,

wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

21. A method according to claim 14,

15 wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

22. A method according to claim 14,

wherein the semiconductor device is one selected from the group consisting 20 of a liquid crystal display device, an EL display device, and an image sensor.

23. A method according to claim 14,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount

display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

24. A device according to claim 4,
wherein the semiconductor device is one selected from the group consisting
5 of a liquid crystal display device, an EL display device, and an image sensor.

25. A device according to claim 4,
wherein the semiconductor device is one selected from the group consisting
of a portable telephone, a video camera, a portable information terminal, a head mount
display, a projector, an electronic portable book, a personal computer, a DVD player, and
10 a digital camera.

26. A device according to claim 5,
wherein the first insulating layer comprises at least one selected from the group
consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and
a tantalum oxide film.

15 27. A device according to claim 5,
wherein the second insulating layer comprises at least one selected from the
group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film,
and a tantalum oxide film.

28. A device according to claim 5,
20 wherein the semiconductor device is one selected from the group consisting
of a liquid crystal display device, an EL display device, and an image sensor.

29. A device according to claim 5,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

5 30. A device according to claim 6,

wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

31. A device according to claim 6,

10 wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

32. A device according to claim 6,

wherein the semiconductor device is one selected from the group consisting 15 of a liquid crystal display device, an EL display device, and an image sensor.

33. A device according to claim 6,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and 20 a digital camera.

34. A device according to claim 7,

wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and

a tantalum oxide film.

35. A device according to claim 7,

wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, 5 and a tantalum oxide film.

36. A device according to claim 7,

wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

37. A device according to claim 7,

10 wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

38. A device according to claim 8,

15 wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

39. A device according to claim 8,

wherein the second insulating layer comprises at least one selected from the 20 group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

40. A device according to claim 8,

wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

41. A device according to claim 8,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

42. A device according to claim 9,

wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

43. A device according to claim 9,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

44. A device according to claim 9,

wherein the first concentration is not less than 25 atomic % and less than 50 atomic %, while each of the second and third concentration is not less than 5 atomic % and less than 25 atomic %.

20 45. A device according to claim 9,

wherein the semiconductor island includes a source region, a drain region, a channel region and a pair of LDD regions,

wherein each of the LDD regions includes a first portion which is overlapped

with the gate electrode with the gate insulating film therebetween and a second portion which is not overlapped with the gate electrode.

46. A method according to claim 15,

wherein the first insulating layer includes a first silicon nitride oxide film
5 having a nitrogen concentration of not less than 25 atomic % and less than 50 atomic %, and the second insulating layer includes a second silicon nitride oxide film having a nitrogen concentration of not less than 5 atomic % and less than 25 atomic %.

47. A method according to claim 15,

wherein the first insulating layer comprises at least one selected from the group
10 consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

48. A method according to claim 15,

wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film,
15 and a tantalum oxide film.

49. A method according to claim 15,

wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

50. A method according to claim 15,

20 wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

51. A method according to claim 16,

wherein the first insulating layer includes a first silicon nitride oxide film having a nitrogen concentration of not less than 25 atomic % and less than 50 atomic %, and the second insulating layer includes a second silicon nitride oxide film having a 5 nitrogen concentration of not less than 5 atomic % and less than 25 atomic %.

52. A method according to claim 16,

wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

10 53. A method according to claim 16,

wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

54. A method according to claim 16,

15 wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

55. A method according to claim 16,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount 20 display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

56. A method according to claim 17,

wherein the first insulating layer includes a first silicon nitride oxide film

having a nitrogen concentration of not less than 25 atomic % and less than 50 atomic %, and the second insulating layer includes a second silicon nitride oxide film having a nitrogen concentration of not less than 5 atomic % and less than 25 atomic %.

57. A method according to claim 17,

5 wherein the first insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

58. A method according to claim 17,

10 wherein the second insulating layer comprises at least one selected from the group consisting of a silicon nitride film, a silicon oxide film, a silicon nitride oxide film, and a tantalum oxide film.

59. A method according to claim 17,

15 wherein the semiconductor device is one selected from the group consisting of a liquid crystal display device, an EL display device, and an image sensor.

60. A method according to claim 17,

wherein the semiconductor device is one selected from the group consisting of a portable telephone, a video camera, a portable information terminal, a head mount display, a projector, an electronic portable book, a personal computer, a DVD player, and a digital camera.

20 61. A method according to claim 18,

wherein the first concentration is not less than 25 atomic % and less than 50 atomic %, while each of the second and third concentration is not less than 5 atomic % and less than 25 atomic %.

62. A method according to claim 18,
wherein the semiconductor device is one selected from the group consisting
of a liquid crystal display device, an EL display device, and an image sensor.

63. A method according to claim 18,
5 wherein the semiconductor device is one selected from the group consisting
of a portable telephone, a video camera, a portable information terminal, a head mount
display, a projector, an electronic portable book, a personal computer, a DVD player, and
a digital camera.